WATER SECURITY
Knowledge Exchange Programme

Water Security KE Programme Final Report

Final Report of the
Water Security Knowledge Exchange Programme
April 2011 – March 2014

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Date: Thursday 26th June 2014

Report Number: WSKEP Final Report 01

Version Number: 1.0

Acronyms

BIS	UK Department for Business, Innovation and Skills
BGS	British Geological Survey
CEH	Centre for Ecology and Hydrology
CIWEM	Chartered Institution of Water and Environmental Management
CCN	Catchment Change Network
CDP	Carbon Disclosure Project
CREW	Centre of Expertise for Waters
CWC	Changing Water Cycle Research Programme
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EPSRC	Engineering and Physical Sciences Research Council
ESKTN	Environmental Sustainability Knowledge Transfer Network
ESRC	Economic and Social Research Council
EU	European Union
EVO	Environmental Virtual Observatory
FWR	Foundation for Water Research
ICID	International Commission on Irrigation and Drainage
JPI	Joint Programming Initiative
KE	Knowledge Exchange
KEAB	Knowledge Exchange Advisory Board
KEN	Knowledge Exchange Network
KEP	Knowledge Exchange Programme
KTN	Knowledge Transfer Network
LOCAR	Lowland Catchment Research Programme
LOIS	Land Ocean Interaction Study Research Programme
LWEC	Living with Environmental Change
MAR	Managed Aquifer Recharge
MRE	Marine Renewable Energy
OFWAT	The Water Services Regulation Authority
NERC	Natural Environment Research Council
NGO	Non-Governmental Organisation
PAG	Programme Advisory Group
PF	Programme Framework
PHE	Public Health England
PI	Principal Investigator
PMG	Programme Management Group
RCUK	Research Councils UK
RELU	Rural Economy and Land Use Research Programme
RP	Research Programme
SEPA	Scottish Environment Protection Agency
SIM	Science and Innovation Manager
SLA	Service Level Agreement
SPS	Specific Priority Subject
SRG	Scottish Resource Group
SuDS	Sustainable Drainage Systems
SWIRL	Surrey Water Innovation Research & Learning
SWW	South West Water
UEA	University of East Anglia
UKCDS	UK Collaborative on Development Sciences
UKWIR	UK Water Industry Research
UKWRIP	UK Water Research and Innovation Partnership
UNESCO	United Nations Organization for Education, Science and Culture
WERH	Wales Environment Research Hub
WSBF	Westminster Sustainable Business Forum
WSKEP	Water Security Knowledge Exchange Programme
WIG	Cross - Research Council Water Interest Group
WP	Work Package

Summary

This document is the Final Report for the Natural Environment Research Council (NERC) Water Security Knowledge Exchange Programme (WSKEP) which ran from April 2011 – March 2014. It highlights the outcomes, benefits and impacts of the Programme's activities, notes key achievements and outputs, describes case examples, presents learning and legacy issues including Programme recommendations and provides a financial statement.

Disclaimer

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1. Executive Summary

This Final report reflects on the achievements and lessons learned from the three year (April 2011 – March 2014) Water Security Knowledge Exchange Programme. It was managed by a Programme Management Group (PMG) on a daily basis and advised by a strong, business led, Programme Advisory Group (PAG) comprising of both users and producers of NERC research outputs. The PAG met three times a year and was chaired by Michael Norton OBE, Global Water Director at AMEC Environmental & Infrastructure.

The main purpose of WSKEP was to accelerate the uptake of research by end users, in particular by businesses but also by policy-makers, regulators and Non-Governmental Organisations (NGOs) and help inform the direction of future science. This was done by conducting and coordinating a diverse range of Knowledge Exchange (KE) activities, some of which brought together scientists and end users at events to exchange ideas and create projects and partnerships that addressed the needs of the end users. Other activities lead to the production of reports and journal papers or set up schemes to encourage the translation of research results to end user products and services. Web based tools were also delivered which allow users to search for scientists working in their field, find national datasets of relevance or case studies of where other users have resolved similar problems by working in collaboration with researchers.

The Programme culminated in a very successful Reception in Westminster, where the key note speech was given by the Rt Hon David Willetts MP, Minister for Universities and Science. It brought together high level representatives of all the companies that WSKEP had been engaged with, plus others where water related risks were an important issue to their businesses. The reception provided guests with an opportunity to network with many scientists.

Although the Programme has now ended, its legacy will continue. Many relationships have been established which individuals have the opportunity to build upon. The online tools have been combined into a new Water Security Knowledge Exchange Portal (http://www.watersecurity.org.uk/) which will remain active and in the public domain for the foreseeable future.

2. Programme Overview

Programme Objectives

The aim of WSKEP has been to accelerate the uptake of research and help inform the direction of future science to ensure sustainable use of our water in the future.

NERC-funded research produces knowledge, expertise and skills that can provide significant benefits for the environment, for the economy and for the general well-being of society. Knowledge exchange plays an important role in delivering these benefits.

The overarching purpose of the KE programmes was to accelerate the uptake of research and help inform the direction of future science. This was done by conducting and coordinating a range of KE activities which:

- Effectively brought together the NERC-funded research community across all Research Centres and Higher Education Institutes that deliver science in the relevant programme area, and built on their strengths and multidisciplinary capabilities.
- Proactively engaged current and potential users of NERC-funded research, particularly in business, but also among policy-makers, regulators and NGOs.
- Systematically identified the key needs and science challenges faced by end-users.
- Stimulated the exchange of knowledge, the flow of people and the creation of projects and partnerships that addressed the needs and capitalised on the opportunities they presented.

Key Outcomes, Benefits and Impact

Listed below are the **key outcomes, benefits and impacts** resulting from WSKEP activities:

- The WSKEP Reception on ‘Improving Resilience of Businesses to Water Related Risks’ held in Westminster in November 2013 was considered a success. It had the dual purpose of bringing together high level representatives

from industry, government and academia to network and collaborate as well as to discuss recent initiatives that would encourage innovation in water management. The various science initiatives on display benefitted from the interest of users and Duncan Wingham set a challenge to the audience that was subsequently picked up and discussed by the PAG. During the evening the keynote speaker, The Rt Hon David Willetts, was invited to visit the Centre for Ecology and Hydrology (CEH). He is now more aware of the issues facing the water industry as a whole.

- As a result of the Phase 1 Workshops, WSKEP commissioned AMEC to identify whether any synergies existed between agriculture and the Water Utilities in relation to the management of water. The findings of their report were presented at a meeting in June 2013. Since then a further meeting with Water Companies and the Environment Agency (EA) amongst others was held on 21st March 2014. This meeting prioritised the findings of the report and discussed the way forward for the top two synergies which related to water quality and agricultural water storage. The production of the Workshop report was the most popular news story in the WSKEP May 2014 e-zine and contributed to reaching the highest number of visitors ever to the website. Visitors to the site have offered further contributions to the report which have been followed up.
- A meeting on 'Exploring the opportunities and barriers to much larger scale aquifer storage and recharge than has so far been practised in the UK' brought together 20-30 experts from academia, the EA and the water utilities on 4th December 2013. WSKEP sponsored this event, with support from the British Geological Survery (BGS), UK Water Industry Research (UKWIR) and the UK Water Research and Innovation Partnership (UKWRIP). The meeting created and explored new ideas and further potential for 'Managed Aquifer Recharge' (MAR) in the UK. The resulting recommendations are that the UK develops large scale test-bed facilities for MAR and that UKWIR and BGS partner on aquifer storage and recharge research.
- Following on from a Phase I Workshop, WSKEP sponsored the Wales Environment Research Hub (WERH) to organise what was a very successful workshop on 'Communicating Environmental Science' in June 2013 at which NERC was represented. The meeting was oversubscribed and people had to be turned away. As a result of this, there was a demand for a further workshop which Mark Everard organised called 'Communicating science for sustainable practice' which was held at the University of West of England on 27th - 28th November 2013. Shaun Russell, the Director of WERH wrote 'The Welsh Government were so impressed with the training workshop that they have asked my Unit to prepare a proposal for yet another event that would expose Government staff specifically (across all departments and not just environment) to the communications theory, skills and case studies that we covered in the WSKEP workshops. ... so you can see the excellent multiplier effect and impact that the activity has had and continues to have.'
- WaterR2B, the Programme case study website, was launched at the High Level Event in November 2013 with over 40 case studies across 8 different sectors. WSKEP sought feedback on the style, length and information content etc and as a result of the survey responses, have generated a further 30 studies to upload. They all illustrate how industry has used scientific research to solve a real world problem for example: 'Is building an irrigation reservoir the right option for farmers?', What effects do cytotoxins in drinking water have?' and 'How can new models help minimise the costs of flooding?'
- The Water Research Directory was launched in April 2012 with 300 entries and now has over 1000 entries. It is the only comprehensive listing for the UK. The tool was designed to promote collaboration and to accelerate users (business and policy) access to NERC and other research funded water science. It has achieved its aim as it receives about 150 enquiries every month. It also contains pages on the University Research networks and hydrological research facilities. Both pages, like the main researcher catalogue are self populating and have increased the functionality of the directory. Recently it was written into a proposal to provide a call down service to undertake evidence reviews for Defra's Water Availability and Quality (WAAQ) Programme ie implementing the standard evidence review methodology which was developed by James Miller with WSKEP funding.
- During the life of the Programme, the WSKEP website has consistently ranked between 3rd and 6th on Google (out of over 800 million returns) for the generic search term "water security". It has featured on the first page for the same search for nearly two years. There are no other NERC sites in the top 50. Unique visitor figures have averaged at just over 900 per month in 2013 and 2014 whilst being about 650 per month during Q4 2012 when the site was building its reputation. This exceptional level of achievement has been due to the way new technologies for example twitter were taken up at the start and used to the Programme's advantage.
- WSKEP has been closely linked to the UK's country partner role in the European Joint Programming Initiative (JPI) on Water, and has successfully engaged with government departments in that initiative.
- WSKEP co-funded several British Water actions to encourage their members to engage more actively with the research community. These included Innovation Days, where researchers and British Water members presented the latest research and innovation to water utilities and Focus Group meetings. The Innovation Days provided an environment where SME's, researchers and large water utilities could meet and discuss industry needs and

research capabilities. The first 13 Innovation Exchanges that British Water held delivered 453 10-minute presentations in 49 workshops putting 778 individuals from 164 different suppliers in front of 408 people from 14 client organisations (water utilities). Indications are that 30-40% of suppliers have had further, fruitful discussions with clients and/or other suppliers about developing or adopting their innovations. The two British Water Focus Groups (Sustainable Urban Drainage (SUDS) and Fats Oils and Greases (FOG)) access research skills and discuss industry requirements. The efforts of both these groups aim to improve performance of sewer systems, support high priority research interests in diffuse urban pollution, and in urban flooding. Actions included closer linkage of these groups to the NERC Research Programme in Flooding, and in supporting a case for future research on diffuse urban pollution.

- As a result of the Phase 1 Workshops, WSKEP commissioned a piece of work aiming to improve KE related to the health impacts from flooding by identifying high risk populations. This work was carried out by Public Health England (PHE). They hosted a workshop on 30th January 2014 that coincided with another workshop PHE were hosting for the EC PHASE project they are leading on the flood work package. The workshop was called Flooding and GIS systems and the participants included PHE, the Health and Safety Executive, the National Health service (NHS), the UK Met Office, the Flood Forecasting Centre, the EA, CEH and BGS. New areas of data exchange were agreed, some of which will go forward immediately. A concept note was prepared by PHE that outlined future steps and potential funding sources for improvements / inter-operability of data and systems. Public Health England's advice to the public for before, during and after flooding can be found on its website.
- Richard Blackmore of Research Impact Consulting produced a report on behalf of WSKEP showing that participants at the Phase 1 Workshops had made new contacts and were developing collaborative research (eg Manchester airport working with Lancaster University), and forming agreements to work together on submitting proposals and winning bids.
- WSKEP support for the NERC Catchment Change Network (CCN) has enabled this network to remain the preferred route for delivery of a knowledge hub for the Department for Environment, Food and Rural Affairs (Defra)/EA catchment based approach. WSKEP support has also ensured that other NERC data, knowledge and expertise will be an integral part of the next generation of web based knowledge provision to stakeholders (third sector organisations, industries, consultants and government bodies) involved in implementing the catchment based approach across England and Wales.

Summary of Key Activities

The description below lists the **key activities and achievements** by Work Package (WP).

WP1- Identify key needs and science challenges faced by the users

This Work Package was about identifying the subjects that would form the basis of the Programme Workshops. A set of five Sub Areas was agreed by the PAG in May 2011, three of which were prioritised to be the main area of focus for the first 18 months. A Launch event was held in London on 28th June 2011. It brought 36 users and 16 researchers together with the aim of identifying three Specific Priority Subjects (SPSs) for each of the three selected Sub Areas. (See Appendix I for the resultant titles.) WP 3 implemented the Workshops (see below). Half way through the Programme the NERC KE Advisory Board (KEAB) requested a revised approach to the way WSKEP interacted with businesses. Instead of hosting more workshops in the remaining two Sub Areas, a) plans for the Data Sub Area were revised so that a Water Data Portal could be produced, b) Sub Area 5 was laid aside and c) WSKEP spent time identifying businesses to engage with in order to determine their KE needs. (See WP3 for details)

WP2 - Identify the science that matches the key needs of the users

WP2's main task was the creation of a Water Research Directory (http://www.ukwaterresearch.net/) (Figure 1). It lists PI's and Co-PI's of freshwater projects in the NERC Grants on the Web (GOTW), and is further enhanced with details of a) researchers who have attended WSKEP events, b) from web searching University websites, or c) researchers who have self-registered their interest in being included in the Directory. At this time there are over 1000 researchers listed. It also contains information on water research and demonstration facilities in the UK, showing these on an interactive map. There are currently 26 facilities listed. This is the first comprehensive listing for the UK. Finally it contains a Directory of University Water Networks which has the facility for people to submit their own networks. There are at present, 7 listed. The Directory is becoming a very useful resource for businesses and Government Departments (e.g. UK Trade & Investment), allowing them to search for researchers in their specialist fields of interest.

The other objective of this WP was to establish an Industry Impact Award Scheme where proposals were invited for small knowledge exchange grants of £5-£10K. The Scheme ran from April 2013 – March 2014. It attracted 6 full proposals plus a further 6 enquiries about the scheme. The proposals were reviewed by the PMG and those that were eligible for funding were then evaluated by two relevant members of the PAG. In the event, only one was accepted with a grant being awarded. The scheme was widely advertised a number of times to the Water security community to help stimulate a greater number of applicants.

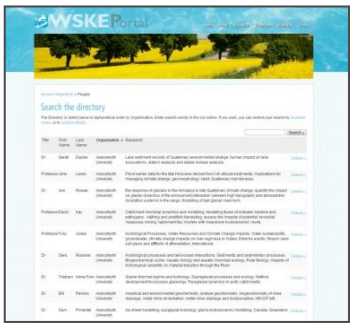

Figure 1 UK Water Research Directory

Finally WP2 identified and distilled from past, current and future NERC funded Research Programmes (RP), industry specific outputs and potential impacts. This involved contacting existing RP Programme Offices as well as the NERC Science Delivery team. The report can be found on the WSKEP Programme website: (http://www.wskep.net/assets/documents/NERCfundedResearchProgrammesoutputsrelevanttoindustry.pdf)

WP3 - Organise Events and Activities to bring together the users and scientists

This Work Package was divided into three parts, 1) the management the Programme Workshops, 2) activities with users to identify areas where WSKEP could support their programmes of work and 3) activities to increase impact from recent Research Programmes.

The management of the Programme Workshops

WSKEP designed and organised ten Sub Area Workshops that were hosted by different organisations geographically spread across the UK. They were all lead by Peter Woodward of Quest Associates Ltd, a scientific facilitator who was able to bring a coordinated approach to the family of workshops and ensure that there was effective participation from the delegates. The Workshops were all well attended with representation from key individuals from relevant invited organisations. New partnerships we forged and discussion produced excellent synthesis of the major challenges in the respective priority subject areas. Participant reports were circulated to all who attended and Summary reports were published on the website. A Sub Area Development Meeting was held in June 2012 where the research recommendations from all the Workshops were discussed and prioritised for further action by WSKEP. The top ten were completed in the second half of the Programme. One of the objectives of the Workshops was to initiate collaboration between the researchers and users that attended. The PMG commissioned Richard Blackmore of Research Impact Consulting to gather information by questionnaire about these collaborations and recommend new approaches that could be included in any future workshops to increase the number and effectiveness of post-event collaborations. The report 'Collaborations arising from WSKEP Workshops' has been published on the website. The survey found that 50 out of 71 respondents had identified potential collaborations as a result of the workshops, and that 73 bilateral discussions had been held subsequent to the WSKEP Workshops. Despite the short time between the end of the workshop programme and the survey, 27 collaborations had already been initiated, or were being planning.

The redesigned Data Sub Area produced a Water Data Portal (Figure 2). It delivers a comprehensive catalogue of national water-related data that are of interest to a range of stakeholders. The data are divided into three sections, groundwater data, surface water data and atmospheric data. The portal provides a perspective on the data, how useful they are, how to access them (with some video clips) and allow users to comment on the datasets. It went live in June 2014 so it remains interesting to see how businesses will pick it up and use it to identify datasets of interest relevant to their studies.

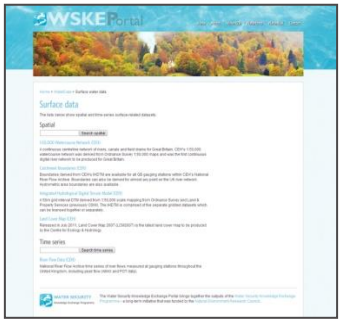

Figure 2 The Water Data Portal

Activities with users to identify areas where WSKEP could support their programmes of work

Much of the effort of the WSKEP Programme fell into this section of WP3. In the first half of the Programme, User Based Activities focussed on the delivery of several projects requested and funded by Defra/EA. Actions included monitoring progress on: a Guidance document for undertaking Quick Scoping Reviews and Rapid Evidence Assessments, national water quality scenarios using UKCP09, a Systematic Review on natural, restored and constructed wetlands and planning for an international conference on methods for determining environmental flows. These were fully funded by Defra/EA. The Guidance document was subsequently applied to two evidence assessments which Defra approved. Work continued in the general area of identifying methods and tools by which Defra/EA could access policy relevant knowledge from the vast amount of national, European and international research.

In the middle of the Programme, WSKEP concentrated efforts on building relationships with key industry user groups, and working with their established academic partners to increase and diversify that industry's access and use of NERC science. Key industry sectors included water utilities (where Exeter University was commissioned to extend the work they were doing with South West Water on carbon sequestration to four other water utilities), the grocery sector where WSKEP worked with Cranfield University to expand current work on increasing resilience to droughts, and with the financial sector (The Carbon Disclosure Project (CDP) - Water and the Financial Service Knowledge Transfer Network (KTN)) to identify topics where academic partners can work with CDP-Water and its partners in the financial sector.

In the last phase of the Programme, WSKEP focussed on discussions with businesses including water companies, infrastructure companies, electricity generators, extractive industry, the consulting sector and British Waterways. WSKEP supported the involvement of academics in water innovation actions being run by trade and professional associations – eg British Water, Water Industry Forum and Water Innovation Network. WSKEP also took on board the recommendations that had come from the Phase 1 Workshops. One of these was to raise the profile of health impacts of extremes and in particular flood events. Public Health England organised a workshop on behalf of the PMG to discuss this topic. Another task was to identify synergies between agricultural and water utility users around the management of water. The PMG commissioned AMEC to prepare a report which collated the fragmented information on the subject. The results were then discussed at a workshop where plans were made for the two most promising synergies. A third task was to review the efficacy of communication plans for drought conditions during the 2010 – 2012 drought. The PMG asked Waterwise to see what could be done to improve communication with the general public about water saving initiatives. This report is underway but still outstanding.

Activities to increase impact from recent Research Programmes.

In partnership with the Programme Managers of the Changing Water Cycle (CWC) and Storm Risk Research Programmes (Graham Leeks) and the programme manager of the Macronutrients Programme (Paul Whitehead), WSKEP developed a protocol whereby WSKEP supported these NERC Research Programmes. This protocol allowed PI's and the Programme Management team to build upon the Impact Plans of each funded project, prepare a programme level synthesis report identifying common areas of user engagement and develop a plan for delivery of programme level KE activities. WSKEP offered complementary support to these programme level KE activities and provided opportunities to promote them and other research programmes at most of the meetings they organised.

Based on outputs from the Rural Economy and Land Use (RELU) Programme, Lancaster University completed a Case Study / Best Practice guide on the local stakeholder involvement in catchment management schemes. This was made available through the Catchment Change Network (CCN) Knowledge Hub to those involved in the Defra/EA catchment based approach. Due to staff constraints Imperial College withdrew from its initial undertaking to run a KE activity with the consulting sector and the EA on the use of the improved groundwater modelling of the unsaturated zone that was developed under the Lowland Catchment Research Programme. WSKEP therefore proposed that it should be considered further within the NERC Changing Water Cycle Research Programme. This has taken place within the HyDef project of the CWC Programme which has used Lowland Catchment Research (LOCAR) data and study sites. Also related to this, a Defra funded catchment modelling project began in April 2014 which is linked to the Macronutrients programme.

Another task was about synthesising outputs from recent and current ecosystem services research initiatives. WSKEP commissioned the Environmental Sustainability Knowledge Transfer Network (ESKTN) in collaboration with the Ecosystems Knowledge Network (EKN) to engage agri-food businesses and retailers at the UK regional level to gain a better understanding of using water-related ecosystem service valuation tools. The goal being for these businesses to be able to manage risks and respond to opportunities. A workshop was held, further actions agreed and the report is now available. (http://www.wskep.net/news.php?id=253 and http://www.wskep.net/assets/documents/Business-engagement-in-valuing-and-implementing-water-workshop.pdf)

The final task was about reviewing plans for Current RPs and identifying potential decision support tools. This was completed in association with a WP2 task and the report can be found on the Programme website: (http://www.wskep.net/assets/documents/NERCfundedResearchProgrammesoutputsrelevanttoindustry.pdf)

WP4 - Connect and coordinate KE across NERC

This Work Package was organised in two parts, part 1) was about connecting and communicating with other groups whilst part 2) concerned the management and maintenance of the WSKEP website.

Connecting with other Groups

WSKEP opened and maintained links with many different groups, networks and institutions throughout the 3 year Programme. In terms of NERC groups, WSKEP members attended all the NERC Knowledge Exchange Network (KEN) meetings to learn about other KE activities, network with other KE members and exchange views. On several occasions WSKEP PMG members provided updates on the Programmes activities. WSKEP undertook activities jointly with and added value to the NERC KE Fellows. WSKEP met them at the KEN meetings and helped them by sponsoring and advertising their events, putting them in contact with others working in their field and inviting them to the Programme events. WSKEP stayed in touch with the NERC Marine Renewable Energy (MRE) Knowledge Exchange Programme (KEP) allowing the groups to discuss progress and experiences and exchange information on how the programmes were developing. WSKEP had discussions with those setting up the new NERC Drought and Flood calls. Ned Garnett (NERC Atmospheric Sciences, Science and Innovation Manager) used the outcomes from the two WSKEP Workshops on drought management to convince the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC) to co-fund this new RP. WSKEP also supported the NERC CCN which enabled it to remain the preferred route for delivery of a knowledge hub for the Defra/EA catchment based approach.

WSKEP has been involved in many other KE Networks. WSKEP worked with WERH on several workshops on communicating environmental science and held many discussions with the Scottish Centre for Excellence in Water Research (CREW). It met with the key trade and professional associations to discuss how they could improve collaboration by actively sharing knowledge on the science and management of water and worked with a number of Academic Water Groups such as the N8 Research Partnership, Water @Leeds, Water at Oxford, Surrey Water Innovation Research & Learning (SWIRL) at Surrey and others. WSKEP created and maintained links throughout with the Living with Environmental Change (LWEC) Programme and later collaborated with the Government Office for Science - LWEC UKWRIP Initiative. WSKEP supported and attended a number of UKWRIP Workshops and events and have recently developed a Water Portal which UKWRIP will access direct from their website.

The WSKEP website

The WSKEP website (http://www.wskep.net/index.php) (Figure 3) has grown and developed during the Programme. It is now a well respected site for water security information, accessed at all levels including by MPs. The events calendar is kept up to date with WSKEP and other national and international conferences and meetings. Newsletters (e-zines) are sent out monthly highlighting WSKEP activities and others supported by the Programme. Tweets are posted nearly every day as well as when the website is updated. WSKEP now has over 1000 twitter followers.

Figure 3 The WSKEP website

WP5 - Communicate with the science and user communities

This Work Package is in two parts, part 1) is about writing and maintaining a Communication Plan whilst part 2) covers the organisation of a High Level event.

The WSKEP Communication Plan was a living document and was updated regularly during the life of the Porgramme. Each version was presented to the subsequent PAG meeting for review and discussion. The document remains active as the tools remain live under the new custodianship of CEH Wallingford. (See Section 5, Programme Legacy)

WSKEP hosted a Reception called 'Improving Resilience of Businesses to Water Related Risks' at Central Hall Westminster on Wednesday 6th November 2013. There were four speakers, the Rt Hon David Willetts MP, Prof Duncan Wingham, Chief Executive of NERC, Colin Drummond, Chief Executive of Viridor and joint CEO of Pennon Group plc and Mark Fletcher, Global Water Business Leader for Arup. The aim of the event was to raise the profile of NERC science being used by businesses. It brought together high level representatives from industry, government and academia to discuss recent initiatives to encourage innovation in water management. There were two sponsors, Arup and British Water and seven banners around the room that displayed different science and KE initiatives. The initiatives represented were BGS, COsmic-ray Soil Moisture Observing System UK (COSMOS-UK), Hydrological Outlooks, Met Office, Water@Leeds, SWIRL and WaterR2B. WaterR2B was launched and the UK Water Research Directory was promoted. Duncan Wingham invited the attendees to discuss ways in which NERC could carry out Knowledge Exchange activities with business, which has resulted in some follow on discussions. An article was written up about the event (http://www.wskep.net/news.php?id=295) and a short video prepared showing highlights of the evening (http://www.wskep.net/news.php?id=296).

As a result of the evening David Willetts requested an opportunity to visit CEH to see the work they do on water related issues. That visit was arranged for 27th January 2014 and was a success. He was presented with one of the first copies of the CEH Science Strategy 2014-2019 by the CEH Director.

WP6 - Act as a KE Ambassador

This WP was an ongoing activity throughout the Programme whereby the good practice in relation to KE was shared among the NERC community. Opportunities to share experiences were undertaken whenever possible. WSKEP interacted with other NERC KE networks and programmes, those of other Research Councils, other University led proposals, initiatives sponsored by government departments and devolved governments, trade and professional associations and European and international KE networks. Across this wide range of communities, WSKEP was able to highlight NERC's level of commitment to, and leadership in water related knowledge exchange.

Also included in this WP was the development of case studies of benefit to industry from NERC and other freshwater science. WSKEP developed a dynamic website for many different sectors, from the water utilities, through, farming, energy, consulting and health amongst others to highlight case studies of where working with research organisations, industry has solved some of its challenges and needs. The website is called WaterR2B (http://waterr2b.net/) (Figure 4) and was launched at the Westminster Reception in November 2013 containing about 40 case studies. Since then an industry survey was carried out to discover whether this tool was what users required. There was a positive response, so WSKEP continued to build examples of where science and industry have worked together. Another approximately 20 are due to be loaded shortly bringing the total number of case studies to around 60.

Figure 4 The WaterR2B website

WP7 – Management of WSKEP

This WP was created in order to report management issues relating to the Programme. The PMG, which consisted of a Lead, a Project Manager, a Programme Development Manager, a Scientific Advisor and a Coordinator, met on a monthly basis to discuss progress, issues and upcoming events. Minutes were prepared for all meetings and actions followed up.

The PAG consisted of individuals from industry, consultancies, Government Ministries and Agencies who volunteered their time and who were selected in order to provide a diverse range of insights into water KE related issues. The PAG was formed before the start of the Programme, however, some members retired and others joined the Group during the three year period of the Programme. The PAG members provided advice and guidance to the PMG at the meetings; all of which were minuted and actions completed.

The PMG had many responsibilities; these are just a few. It monitored the Programme budget and revised actions in the light thereof. A six monthly financial report was submitted to the NERC KE Innovation team for approval. (See Section 6 for the latest Statement). The PMG regularly updated a risk register based on the System for Targets and Risks (STAR) which was reviewed at the PAG meetings. It was responsible for the branding of the Programme. It used the services of Samui and Cooper RepCo Ltd to develop the style and tools to advertise the Programme. Many contracts were let throughout the 3 years to these companies and other consultancies, all of which were handled by the KEP Co-ordinator. Numerous Workshops and events were organised, hosted and reported on and the website was kept up to date and current. In November 2013 the PMG submitted a proposal for a third phase of WSKEP running from April 2014 to March 2015. This was to be paid for by the then anticipated under spend in the last financial year. This was not granted so the PMG brought the Programme to a close at the end of March 2014.

Key Outputs

The key outputs of the WSKEP Programme were:

1. WSKEP Launch June 2011
2. Ten Workshops with Full Participant Outcome Reports
3. Ten Workshop Summary Reports (http://www.wskep.net/workshop_outputs.php)
4. Sub Area Development Meeting with Full Participant Outcome Report
5. Sub Area Development Meeting Summary statement (http://www.wskep.net/summarystatement.php)
6. Report by Richard Blackmore 'Collaborations arising from WSKEP Workshops' Aug 2012 (http://www.wskep.net/news.php?id=200)

7. Sponsorship for a conference on 'Blueprint for safeguarding European waters' 11 Jan 2012
8. Case Study 'Best Practice from RELU on local stakeholder participation in catchment management' (http://www.catchmentchange.net/about/resource-centre/)
9. Oral presentation of published paper 'The NERC Water Security Knowledge Exchange Programme - it's achievements and remaining challenges' at the British Hydrological Society's 11th National Symposium in Dundee. 11 Jul 2012
10. The UK Water Research Directory - Researcher and demonstration facilities website (http://www.ukwaterresearch.net/)
11. Foundation for Water Research (FWR) Newsletter lead article 'WSKEP soaking up knowledge - A novel approach to supporting sustainable and resilient management of droughts' (http://www.euwfd.com/FWR-Newsletter10-0.pdf)
12. The Westminster Sustainable Business Forum (WSBF) - 'Sustainable Solutions: Raising the water mark' (http://www.wskep.net/news.php?id=196 and http://www.wskep.net/assets/documents/WSBF-Sustainable-Solutions-Raising-the-water-mark.pdf)
13. All Party Parliamentary Water Group – 'Making Innovation a Reality' Brochure (http://www.wskep.net/news.php?id=201)
14. A short guide to Water related searches written by WSKEP and Envirobase team members
15. Guidelines document 'Guidance document for the production of Quick Scoping Reviews and Rapid Evidence Assessments'
16. Sponsorship of the first International Conference on Water Security, Risk and Society held by Oxford University resulting in a Key Issues document (http://www.liamcreative.water2.com.gridhosted.co.uk/conference-reports/) and three Opportunity documents (http://www.wskep.net/assets/documents/nerc-business-water-security.pdf, http://www.wskep.net/assets/documents/nerc-eu-water-security.pdf and http://www.wskep.net/assets/documents/nerc-rcuk-water-security.pdf)
17. Theme Issue compiled and edited by Jim hall, David Grey, Dustin Garrick, Simon Dadson and Rob Hope of Philosophical Transactions of the Royal Society A on 'Water security, risk and Society' vol 371 number 2002, 13 November 2013. (http://rsta.royalsocietypublishing.org/content/371/2002.toc)
18. Exeter University organised think tank 'Avoiding the Perfect Storm: Water Food Energy Nexus' on 24-25 July 2012 plus published report. (http://www.wskep.net/assets/documents/Uni-of-Exeter-Water-Food-Energy-Workshop-Report-Final.pdf)
19. Sponsorship of the University of East Anglia (UEA) Water Security and International Commission on Irrigation & Drainage (ICID) Seminar Nov 2012 (http://www.uea.ac.uk/watersecurity/events/uea-water-security/icid-seminar and Report http://www.uea.ac.uk/documents/40159/0/ICID-irrigation-seminar-report/4c958a30-3b23-4e6e-8834-fc5663e0baae)
20. Support for the NERC Catchment Change Network and the Better Thames Network
21. Sponsorship of work leading to a paper in the journal Environmental Evidence on the effectiveness of reed beds at retaining nutrients from agricultural pollution (http://www.environmentalevidencejournal.org/content/2/1/1)
22. The Industry Impact Award Scheme (http://www.wskep.net/Industry_Impact_Awards.php)
23. Sponsorship of the UK Groundwater Forum Annual Conference on 20th June 2013 (http://www.groundwateruk.org/Communicating-Groundwater.aspx)
24. WaterR2B – the case studies website (http://www.waterr2b.net/)
25. WSKEP Report 'Current research activities relevant to Industry' (http://www.wskep.net/assets/documents/CurrentResearchActivitiesrelevanttoIndustry.pdf)
26. WSKEP Report 'NERC funded Research Programmes outputs relevant to Industry' (http://www.wskep.net/assets/documents/NERCfundedResearchProgrammesoutputsrelevanttoindustry.pdf)
27. ESKTN organised workshop 'Business engagement in valuing and implementing water-related ecosystems services: making the case for the agri-food sector' 14th May 2013 (http://www.wskep.net/news.php?id=253)
28. AMEC Report 'Water Quantity: Synergies between Agriculture and Water Utilities' (http://www.wskep.net/assets/documents/Synergies_between_agriculture_and_water_utilities_Final%20Report.pdf)
29. WERH organised workshop at Bangor on 'Communicating Environmental Science' on 27-28 June 2013 (http://www.werh.org/Communicating%20Science%20workshop/CESworkshop.php.en)
30. Follow up to WERH workshop at UWE, Bristol, on 'Communicating Science for Sustainable Practice' on 27-28 Nov 2013 (http://www.werh.org/UWE%20CES%20workshop/CommunicatingScienceforSustainablePractice.php.en)
31. Sponsorship for British Water Innovation Days and Focus Groups.
32. Support for the Water Industry Forum workshop on 'Dealing with the threat of future water shortages – do we need a UK water grid or is it something else?' (http://www.waterindustryforum.com/member-services/events/wif-events/do-we-need-a-uk-water-grid/)
33. Journal paper: 'The potential of using the ecosystem approach for WFD implementation' (2014) Vlachopoulou, M.1, Coughlin, D.1, Forrow, D.2, Kirk, S.2, Logan, P. 2, and Voulvoulis, N.1(1. Imperial College London - 2.

Environment Agency) Science of the Total Environment 470 - 471 (2014) 688 - 694. (http://www.wskep.net/assets/documents/The-potential-of-using-the-Ecosystem-Approach-in-the-implementation-of-the-EU-Water-Framework-Directive-Final.pdf)

34. A Westminster Reception 'Improving Resilience of Businesses to Water Related Risks' opened by the Rt Hon David Willetts MP. (http://www.wskep.net/news.php?id=295 and http://www.youtube.com/watch?v=tFxzbINbfGQ)
35. FWR Newsletter lead article 'Innovation for the UK Water Community: Opportunities and Barriers' (http://www.euwfd.com/FWR-Newsletter14-0.pdf)
36. All Party Parliamentary Water Group – 'Water Innovation 2013' Brochure (http://appg-water.co.uk/assets/Innovation_2013.pdf)
37. Harper Adams report on 'What impact does the alteration of timing to slurry applications have on leaching of nitrate, phosphate and bacterial pathogens? A Rapid Evidence Assessment.' (http://www.wskep.net/assets/documents/Rapid-Evidence-Assessment-Slurry-application-(280214).pdf)
38. Harper Adams report on 'How effective are farmland interventions for reducing Faecal Indicator Organisms (FIOs) in bathing and shellfish waters (especially Escherichia Coli and Intestinal Enterococci) coming from river catchments? A Quick Scoping Review (http://www.wskep.net/assets/documents/Quick-Scoping-Review-Faecal-Indicator-Organisms-Final%20(270214).pdf)
39. The Water Data Portal – the national water data website (http://www.watersecurity.org.uk/waterdata)
40. WSKEP workshop on 'Innovative and radical groundwater recharge, storage and resource development' on 4 Dec 2013 (http://www.wskep.net/news.php?id=337 and http://www.wskep.net/assets/documents/Radical-groundwater-recharge-workshop-4th-Dec-2013-REPORT.pdf)
41. Support of three WSBF Round table discussions in Westminster. Last meeting held in Dec 2013. http://www.wskep.net/assets/documents/Water-Post-Event-Brief.pdf and http://www.wskep.net/assets/documents/WSBF-Water-Round-Table-Discussion-Summary.pdf)
42. Public Health England Workshop on 'Flooding and GIS: Opportunities for public health' on 30th January 2014 (http://www.wskep.net/news.php?id=338 and http://www.wskep.net/assets/documents/Flooding-&-GIS-Workshop-Report-Final.pdf)
43. WSKEP workshop on 'Improving water knowledge exchange between Trade and Professional Institutions and Associations' on 5 Mar 2014
44. AMEC organised workshop on 'Synergies between agriculture and Water Utilities' on 21 Mar 2014 (http://www.wskep.net/news.php?id=336 and http://www.wskep.net/assets/documents/WSKEP-event-March-21-outcomes-Final.pdf)
45. Waterwise report on 'A review of assessment of communication plans for drought conditions during the 2010 – 2012 period'
46. Six Interim and three Annual Reports to NERC

A list of publications is provided in the metrics spreadsheet.

3. Case Examples

Expanding upon individual examples cited in the programme overview sections, linking activity – output – outcome – benefit/impact (demonstrated through before and after type measures)

This section of the report explains some of the ways that WSKEP endeavoured to engage with stakeholders in order to achieve the main aim of the Programme - to increase the uptake of NERC water related science by users. A number of initiatives were taken forward. Those not completed due to time constraints are mentioned in Section 5, Unfinished Business but the other KE tools and instruments that were used are listed here (in no particular order):

- Case studies
- Phase 1 Workshops
- Communication
- User based activities
- Strategic Partnership
- Working through existing KE networks
- Other meetings and workshops
- Working with NERC groups

Case studies

From the outset of WSKEP it was clear that case studies were to be captured and recorded for the benefit of the users be they businesses, policy-makers, Department for Business, Innovation & Skills (BIS) or NERC. Initially they were to take to form of printed brochures along the lines of those produced by the Environmental Knowledge Transfer

Network in collaboration with the Environmental KTN team for the Network's Priority Technology Areas. However, as time progressed, it emerged that this might no longer be the best way forward for reporting case studies.

The MRE KEP and many of the KE Fellows were also wondering how best to write case studies, so in November 2012, NERC organised a KEN meeting to discuss just this topic. As this was becoming an important issue to WSKEP, three members of the PMG attended that meeting. It was made clear that NERC was changing its focus from reporting outputs to describing outcomes and impacts. Hence our case studies needed to explain the benefits of the research to end users. However, at that stage, there appeared to be no standard way of doing this (headings, length, content etc) or facility for displaying the resulting report. WSKEP therefore identified and reviewed a number of other organisations' hard copy brochures and online databases of case studies and decided to create its own online tool, based on the best elements of all the others. The reason for choosing the online route as opposed to a hardcopy catalogue was that web-based case studies are dynamic, enable linkages to a vast array of supporting material, have a global reach and compliment NERC / Research Council UK (RCUK's) web based communication activities. WSKEP was also able to make use of the latest technologies for example by using twitter, embedding YouTube video clips and using state of the art open source modular software for building the database. The resulting tool is called WaterR2B and it was launched in November 2013 with 40 case studies loaded.

Generating the case studies was a major undertaking. Initially, researchers had to be identified where they had successfully resolved a challenge by working with an end user or customer. Occasionally, end users were approached when it was discovered that they had worked on a problem with a scientist. The benefits of creating a case study were discussed with them and then the report written up. The case studies all took the following format and had length restrictions to ensure they were consistent with one another:

- The challenge
- The solution
- Resulting benefits
- Future directions
- Researchers
- Customers
- Underpinning knowledge
- Similar cases
- Peer reviewed papers
- Further articles

The case studies were loaded into the purpose built WaterR2B tool under the following sectors. A few fell into two categories so were loaded into both:

Energy (7), Farming and Food (8),Recreation, Sport, Leisure and Tourism (4), Water Utilities (14), Health and Emergency Services (4), Planning and Construction (4), Finance and Consulting (3), Industry (5)

The titles of the 40 case studies currently in WaterR2B can be found in Appendix 2. After the launch, our user based contacts were surveyed and asked a series of questions including whether they thought it contained about the right level of information. They were also given the opportunity to describe any changes they thought would enhance the tool. There were 87 responses and one comment from the grocery industry read 'I think it's brilliant and should be replicated across many of the Research Councils as a common format'. All the comments were favourable so further resource has been put into identifying and creating an additional approximately 20 entries. These will be uploaded imminently and advertised via the next WSKEP newsletter.

Phase 1 Workshops – collaboration outcomes

WSKEP organised ten Workshops in the first eighteen months of the Programme (Phase 1). The PAG agreed five Sub Areas within the Water Security theme. The first three Sub Areas held either three or four one-day Workshops on Specific Priory Subjects (See Appendix 1). Users and scientists with a specific interest in the subject area were invited to attend the Workshops which were hosted by organisations working in the field relevant to that workshop. Each workshop followed a standard format and was divided into 4 sessions:

- Setting the scene
- Making the most of current research activity
- Identify areas for future research activity/collaboration
- Alliances, networks and advice to the WSKEP

The workshops were designed to support 3 key aims and objectives:

- To increase awareness and uptake of research outputs in the Subject Area
- To identify user needs and potential future research projects
- To strengthen research/user group collaboration and networks

In total 350 people registered to attend the workshops. The delegates were well distributed across different sectors with 142 coming from academia, 124 from business and commerce, 68 from the public sector and 16 from NGOs. On average, there were 35 delegates per workshop, 106 existing research programmes were showcased and 115 potential new research themes were identified.

Overall feedback on the workshops, provided by anonymous feedback, was highly positive, with 45% of delegates giving an overall rating of Very Good, and 49% giving a rating of Good. This type of feedback however, did not indicate the extent of collaborative activities that were planned or new relationships that had been built. WSKEP therefore commissioned Richard Blackmore to investigate the level of longer term benefits arising from these events. He designed an online survey and sent it to all those who had attended one of more workshops. 71 people responded out of 257. 25 of those indicated that they would be willing to have a follow-up telephone interview and in practice, 16 interviews were held. Of the 71 who responded, 50 (around 70% of the total) reported that they had identified collaboration opportunities, while 21 said that they had not. Delegates were then asked whether these collaboration opportunities had been followed up. 33 had held follow-up discussions with potential partners, and a total of 73 separate bilateral discussions were reported. As may be expected, some delegates were significantly more active than others in following up potential collaborations, with as many as 8 opportunities being followed up by one responder.

'What became clear from individual discussions is that while workshops can help create serendipitous contacts, and assist in the identification of unexpected collaborations, this is only one of their functions. For those delegates that know what they would like to achieve, scrutinise the workshop topics and attendance list in advance, and plan their networking strategy accordingly, workshops can provide a very effective means of achieving their ends.' (Blackmore 2012)

The survey also asked the workshop delegates why any potential collaborations that they discussed at an event had not yet progressed beyond the stage of discussion. The most frequent reason cited for lack of progress was simply lack of time. However, other barriers to collaboration were:

- Structural barriers – these arise primarily from the way in which scientific research is currently organised and funded, and the mechanisms of reward for individual academics.
- Relational barriers – these arise more from failures of communication, and a lack of understanding between potential collaborators of respective cultures, interests and internal drivers.

In broad terms, reducing any *structural* barriers to collaboration is likely to require action by parties such as the Research Councils, University Funding Councils, and Government and is likely to take both significant time and political will. However, WSKEP may have had a significantly greater ability to influence and reduce the *relational* barriers to collaboration. Furthermore, the two types of barrier are not entirely unconnected: a lack of understanding of deeper structural barriers to collaboration is in itself a relational barrier. If collaborators know more about why different parties behave the way that they do, then designing strategies to overcome any structural difficulties becomes very much easier.

Communication

WSKEP realised very early on that communication was going to be vital to the success of the Programme. The nature of knowledge exchange is such that communication is the way forward, the way to ensure collaborations arise between researchers and users and the way to ensure the uptake of NERC science by stakeholders. WSKEP identified the need for a Communication Plan to identify the audiences it needed to communicate with, the way it was going to communicate and the messages it wanted to deliver. The plan would have to include measures to determine whether these messages had been received and acted upon in accordance with the plan. It would also include a timeline of the planned communication activity. The goal would be to see and to implement the communications efforts as a whole and not as a series of standalone activities.

Hence, the PMG contracted Cooper Repco Ltd., a specialised science communication company to help write and implement the WSKEP Communication Plan. As WSKEP was a NERC initiative the main messages became:

1. NERC is committed to improving knowledge exchange as a means to improving water security.
2. NERC is committed to increasing the uptake of its research outputs, in particular by industry to support the growth of the UK economy, well being and environmental quality.
3. NERC is committed to engaging with stakeholders to assist it to define future research funding policy.

A plan with the following components was generated which was kept up to date at regular intervals.

Direct Actions to deliver the messages

- WSKEP events - Phase 1 Workshops, other sponsored Workshops, the Westminster Reception
- Direct meetings - with businesses, policy makers and NGOs
- Third party support - WSKEP Sponsored events such as Working groups, Forums, Parliamentary receptions
- Public relations - WSKEP focused articles describing its objectives and outcomes placed in relevant publications
- Web portal - a major means of communicating with the water security user community
- Hard copy - flyers, banners

Indirect Actions to deliver the messages

- News portal - promotes and publicises activities that promote water security KE
- Events portal - a calendar feature that promotes and publicises events and deadlines relevant to water security KE
- e-newsletter - containing on average 6 news items sent to all contacts in the WSKEP database 10 times a year.
- Social networking - WSKEP's twitter presence and You-Tube channel
- WSKEP-developed online facilities - web tools designed to increase KE, (WaterR2B, the UK Water research Directory and the Water Data Portal)

Overall, this detailed plan enabled WSKEP to generate a great deal of interest in the water security arena, building its community from around 300 people up to nearly 4000. The website is used by MP's to discover information on events and funding opportunities and typing water security into Google brings the WSKEP home page up somewhere on the first page between third and sixth place below only Wikipedia and the US Environmental Protection Agency.

User Based Activities

The Phase 1 Workshops were seen as a way of bringing scientist and users together to discuss a subject area pre-defined by WSKEP. This was highly successful but it did not necessarily identify the individual needs of businesses and regulators. If their challenges did not fall into one of the categories addressed by the Workshops, their needs were left unmet. In order to redress the balance, WSKEP held one to one discussions with a number of organisations for example with Defra/EA who visited CEH on a number of occasions. Stuart Kirk, our Defra/EA contact was also a member of the PAG so was able to provide guidance as well as explain the needs of the organisation. One of the things they requested was a means by which their staff could pose questions for which they were seeking advice from the research community. WSKEP therefore developed and launched a web based tool called e-Respond (http://www.e-respond.net/) (Figure 5) to meet these requirements.

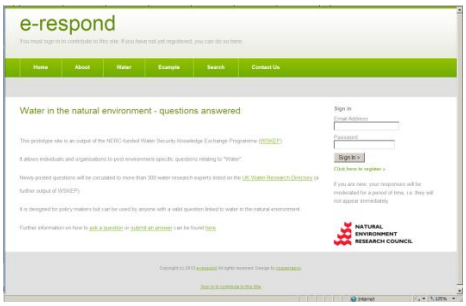

Figure 5 e-Respond

WSKEP have also had discussions with Danone who own Evian water. They wished to be recognised as an international leader in sustainable water resource management. They aim to meet - and where possible exceed - international benchmarks, best practice, norms and standards. Therefore, the company sought advice from organisations that provide scientific support to achieve these aims.

Coca Cola wanted to restore a degraded stretch of river near its bottling plant in south east London. In addition to removing unsightly rubbish, the restoration had to be sustainable, being resilient to both flood and drought events, and it had to re-establish native ecosystems that were consistent with the local area. The company sought expertise from appropriate organisations that were able to help with the environmental and social sciences.

South West Water (SWW) wanted an in-depth assessment of the hydrological conditions of 2012 in South East England against which to assess the performance of their drainage infrastructure during that very wet year. They commissioned a report from hydrological experts at CEH which helped them to assess the true wet weather impacts on the region throughout the year and get the right balance between the impacts of fluvial flooding and the performance of their sewer network. The Head of Waste Water Services at SWW indicated that this had been of very worthwhile significant value in the assessments by The Water Services Regulation Authority (OFWAT), regarding the impacts of fluvial floods, specific to the South West and the performance of their infrastructure.

Water utilities are turning to catchment management techniques to improve raw water quality in order to reduce water treatment costs and reduce energy use in compliance with the UK Climate Act. South West Water is one of the more innovative UK water utilities trialling catchment management techniques to improve raw water quality, and moderate

extreme high and low flows. Researchers from the NERC/ESRC RELU Research Programme have used SWW catchments as test sites, and there are currently more than thirteen universities working with SWW. WSKEP invited key SWW staff onto the Programme Advisory Group and invited SWW staff to speak at and participate in WSKEP workshops and conferences. KE priorities identified by SWW have been taken forward as follow-up actions to one of the SPS workshops. WSKEP funded Exeter University to extend the work SWW had independently undertaken on the use of peat restoration / carbon sequestration schemes to improve water quality. WSKEP also provided data to support the NERC Impact Accelerator Workshop on catchment Sensitive farming and Landscape restoration (13th Sept 2013). Contacts were maintained with SWW through their representative on the PAG. Information from WSKEP and interactions with SWW through the development of the Natural Hazards Partnership (which has trialled some components in the South West), and the Hydrological Outlook project have also provided further points of engagement. The NERC Business Policy and Innovation team have also stepped in to hold discussions with SWW around the Sustainable Food Production priority area.

Scottish Resource Group (SRG) who own Scottish Coal wanted to empty a lake, Loch Fitty, in order to mine the coal reserves from beneath it. This activity would have environmental impacts on the lake and surrounding area and hence the company contacted experts in lake restoration to undertake an ecological impact assessment. The aim was to see if it would be feasible to return the lake to 'Good' ecological status once the coal was mined and the water restored. Although the Scottish Environment Protection Agency (SEPA) approved the plans, SRG required urgent new investment and stakeholder support in spring 2013 and were unable to go ahead with this mine. Instead, they announced the biggest reduction in the UK coal industry in the last decade, closing all but two of their open case mines and making hundreds of workers redundant. (http://coalactionscotland.org.uk/2013/03/scottish-resources-group-circles-the-wagons-the-end-is-nigh/)

Network Rail has to maintain rail infrastructure which is vulnerable to inundation, landslides and erosion associated with extreme rainfall and river flows. They indicated interest in new NERC research on intense rainfall, led by Newcastle University, within the Changing Water Cycle programme. This work gave improved predictive capabilities through use of higher resolution data and models of rainfall events across the UK at scales which were more appropriate to application to critical parts of the national rail infrastructure than had been possible in the past. The integration of NERC research centre/survey capabilities with the Met Office, within the Natural Hazards Partnership, was also highly relevant. Embankment failures and erosion of structures by river flows cause major delays and lead to major maintenance costs and requirements for capital works. Links with Network Rail contacts were established at project and programme levels. They have been invited to a workshop being organised by ARUP and the broad research community represented by the Arts and Humanities Research Council (AHRC), EPSRC, ESRC and NERC on 23rd June 2014 in London. The workshop will focus on questions around the interactions that infrastructure systems have with the people who use them, the places in which they are located and the environment in which they are built. It will stimulate awareness of the possibilities in translating existing research and identifying tangible areas of opportunity and collaborations to take forward into project development.

Strategic Partnership

WSKEP has contributed to the successful signing of two large companies as Strategic partners with NERC and discussions with a third are well underway.

The Global Water Business Leader for Arup has been on the WSKEP PAG for the last three years where advise and knowledge has been shared. In November 2013, NERC signed a three year Memorandum of Understanding (MoU) with global engineering and design company, Arup, in the first strategic partnership of its kind for the UK's largest funder of environmental science.

WSKEP engaged with BP and Shell early on in the second half of the Programme. In the case of BP, the BP PAG member was invited to discussions with the PMG. There were joint interests in ground and surface water resources, water quality and flood hazard risks. She introduced WSKEP to the BP Group Water Expert and a subsequent meeting was held with him. When they launched their book 'Water in the energy industry, An Introduction' they invited members of WSKEP to the event so contacts have been maintained. Shell indicated to the PMG that it used the material and systems that WSKEP made available on the internet, including the Research Directory and overall website. NERC have recently signed a three year Memorandum of Understanding with Shell which will enable Shell to use NERC's world-leading environmental science to help reduce the environmental impact of their operations and projects by providing access to independent, objective advice and information.

WSKEP has also been working with Severn Trent. In presenting a business plan for the next five years (PR14), the regulators (OFWAT and the EA), in response to recent legislation, are placing greater emphasis upon the effective

upstream management, linking infrastructural developments to environmental improvements. WSKEP PMG members supported NERC staff in their discussions with Severn Trent Water plc concerning a strategic partnership between NERC and Severn Trent. This includes a pairing of NERC science expertise with Severn-Trent operational teams, utilising NERC- funded research capabilities relevant to plans for a number of urban demonstration catchments, eg. with regard to both current conditions and future environmental change (and infrastructure development) scenarios for surface water flooding and impacts upon water quality at wider catchment scales in the West Midlands. WSKEP, with NERC, advised Severn Trent on how to take this forward with the academic community. An urban demonstration is being considered as a potential capital bid and Severn Trent are continuing to develop their proposals with links to UKWRIP and the newly developing Cities and Water Action Group. These plans and discussions are ongoing and will help to assess the potential for a long term NERC-Severn Trent strategic partnership.

Working through existing KE networks

WSKEP was well aware of a number of large existing organisations that were active in the water arena. One of its objectives was to work with these networks to complement each other rather than duplicate effort. WSKEP therefore started discussions with them early in the Programme to see where common interests lay that could be built upon.

WSKEP initiated discussions with the Chartered Institution of Water and Environmental Management (CIWEM) and a range of complementary interests were identified. These included:

- Publicising WSKEP and its activities through CIWEM's extensive members lists
- Using CIWEM conferences to reach a greater number of stakeholders and engage in less intensive knowledge exchange activities. This has included both the 'European Union (EU) Blueprint to safeguard Europe's Water' conference and the re-alignment of one of the sessions at the 2012 CIWEM Annual Conference to address the issue of water security.
- CIWEM also helped to facilitate raising the profile of WSKEP and its objectives to parliamentarians.

WSKEP initiated discussions with LWEC at an early stage in the Programme and met with them on a quarterly basis to discuss ways in which the two Initiatives could work together and benefit from each other's knowledge and experiences. Amongst other things this included the sharing of contact database information. WSKEP was kept up to date with the formation of UKWRIP and was able to offer advice where appropriate.

WSKEP worked together with the ESKTN in a number of ways. They are funded by the Technology Strategy Board and their remit is to stimulate innovation by promoting collaboration, best practice and knowledge sharing which sits well with WSKEP. PMG members regularly met with ESKTN staff to share knowledge, expertise and opportunities. Several of the Phase 1 Workshops raised a priority to investigate the issue of water for food and ecosystem services. WSKEP took this on as one of its Phase 2 tasks and asked the ESKTN to organise a workshop to discuss this point. This took place in May 2013.

WSKEP had close links with the British Hydrological Society as a number of the committee members work at CEH. WSKEP wrote a refereed paper for its 11th National Symposium in July 2012 in Dundee and gave an oral presentation at the event. The talk provided an opportunity to advertise the work of the Programme to increase the uptake of NERC science by businesses and to inform the research community of the progress WSKEP was making as a vehicle for them to disseminate relevant science.

WSKEP also had good ties with the International Commission on Irrigation and Drainage (ICID) which provided some international promotion for the Programme. WSKEP jointly sponsored a workshop with the ESKTN which was organised by ICID.UK and the UEA Water Security Research Centre on 'Irrigation policy in a time of drought and high food prices'. The workshop examined global and local irrigation policy in the context of drought and high food prices. The 2012 droughts in the UK, the US and Indo-Gangetic Plain plus current high food prices provided the background to this seminar. The broad question that guided this workshop was: 'In a time of climate change and food scarcity, can better irrigation policies reduce food vulnerabilities?' At the end, the fundamental idea that emerged was that an integrated approach to irrigation management is essential in order to effectively meet food security in a global context characterised by rapid demographic growth, rising food prices and climate change.

The Westminster Sustainable Business Forum (WSBF) is a high-level coalition of key UK businesses, parliamentarians, civil servants and other organisations, seeking to promote effective sustainability policy in the UK. WSKEP worked with them on several occasions to raise the profile of water security issues amongst its community. One of the meetings WSKEP sponsored was on 'Water Seminar: Policy for a sustainable future' in May 2012. Prior to the introduction of a Draft Water Bill at the end of 2012, this seminar provided an opportunity for delegates to discuss the Government's vision for the water sector over the next few decades. The seminar also provided an occasion for

some of the industry's most influential organisations to describe what measures they were currently developing and the event's break-out sessions allowed delegates to examine the various themes associated with the Government's 2011 White Paper: Water for Life. These sessions covered the topics of systems thinking, abstraction/infrastructure reform and water efficiency.

The quality of the UK's trade and professional institutions and associations is a national asset that is the envy of many other countries. In many areas we are world leaders in the delivery of benefits to individuals, professions, industries, and government. WSKEP commissioned a mapping exercise in 2013 which identified approximately one hundred different trade and professional institutions and associations working on some aspect or other of water and related issues. As a result of this, WSKEP sponsored a meeting in March 2014 with 12 of the major trade and professional associations to see if they felt there was a need for improving how they interact with each other. The meeting identified six things that they would do to improve communication and interaction between their organisations. They are now undertaking these actions.

Other meetings and workshops

WSKEP used other meetings and workshops as a means of engaging with a different range of stakeholders that may not have otherwise have come into contact with NERC science. For example WSKEP organised a meeting with AMEC to discuss the synergies between agriculture and water utilities which was attended by not only the Environment Agency and the water companies but also the Country Land and Business Association, the UK Irrigation Association and a variety of consultants interested in this area.

WSKEP also took the opportunity to sponsor a workshop on managed aquifer recharge in order to bring together a group of 30 invited guests from the Environment Agency, Drinking Water inspectorate, Water Utilities, British Geological Survey, Centre for Ecology and Hydrology and UK based consulting and drilling companies. The event was held in response to UKWIR and UKWRIP requirements to investigate radical ways to recharge and store groundwater.

Another example of WSKEP bringing together a wide and diverse audience was at the UK Groundwater Forum Annual Conference which had as its theme 'Communicating Groundwater – Bringing understanding to the water table'. One of the key messages coming from the Conference was the importance of the water community speaking to the public and decision-makers with one unified voice. The other key message was that there is a need to get groundwater on the National Curriculum and better represented in schools as follows:

- Push to include Groundwater in both the Science (Chemistry) and Geography curriculum.
- Aim to get groundwater included specifically in the water cycle, looking at how groundwater accumulates and its vulnerability to over-exploitation and contamination.
- Get the basics of groundwater in the geography curriculum - groundwater is found within the pore spaces, fractures and dissolution features within rocks, not in underground rivers.
- And, emphasise the reliance of the UK, in certain areas, on groundwater as a potable water supply.

As of mid March 2014 after much effort and exchange of letters with the Rt Hon Michael Gove MP, Secretary of State for Education, it is looking as if Groundwater will not feature in the revised GCSE level National Curriculum. This was very disappointing news. The final document is expected shortly.

Working with NERC groups

Like the professional institutions and networks, NERC has its own array of groups that have an interest in water in one way or another. It was important for WSKEP to know what these groups were discussing and planning so that their work would compliment that of the other groups rather than duplicate it. Some of the groups included the MRE KEP, the KE Network, the KE Fellows and the cross Research Council Water Information Group (WIG).

4. Programme Deliverables and Metrics (Milestones and metrics)

Summarising achievement against plan and describing major deviations

The table in Appendix 3 shows outputs that were delivered by the WSKEP Programme and the date by when they were completed. An explanation of any deviations from the plan is given in the last column. An Excel file of metrics (as supplied by NERC at the start of the Programme) is also presented with this report.

5. Learning and legacy

Problems encountered

Highlighting key issues which hindered delivery, both internal - inc. NERC - and external – e.g. challenges in working with the user and research community, and solutions applied

This section lists a series of points (in rough chronological order) that have been compiled by the PMG over a period of time. Some of the first few points arose as a result of the final PAG meeting where the PAG and PMG were asked to comment on learning experiences from the last three years.

At a UK level it was and is not clear to WSKEP or other stakeholders what the vision is for UK Water plc in the next 50 years. No one seems to have responsibility for owning or developing a vision to create a common purpose. Such a vision needs to come at a senior Government and political level and extend far beyond the research councils to all those with an interest in water. Without this vision it is difficult for organisations to give a consistent message in the international market. This is something that the Dutch are very good at and which the UK would wish to work towards. This is obviously a high level objective but had there been a clear structure or framework within the UK, it would have been easier to see where WSKEP fitted into the picture and how to make the best use of resources, expertise and time. In its absence, WSKEP was guided by the members of the PAG.

Another difficulty in furthering water R&D knowledge exchange manifests itself in the fact that the water theme is often not strongly identified in higher level structures of the policy and business players. Until this situation improves and water moves up the political agenda, it will always be hard to implement KE in a holistic manner.

This Knowledge Exchange Programme was initiated by a three year process and revealed a scale of need and opportunity However, at the end of the Programme, KE doesn't finish there, it needs to be sustained going forward. NERC's policy is to fund a series of programmes and projects that are not necessarily connected and in this case there was no follow on project available. Stakeholders have built up a relationship with NERC scientists but it may be difficult to keep connections and collaborations going into the future, with no programme to backup individual efforts.

NERC Swindon Office's focus was on ensuring that WSKEP put its efforts into only NERC funded science, rather than water science irrespective of who funded it or where it had taken place. For many stakeholders, this concept inhibits broader KE. They often express interest in issues which cut across different research organisations and in particular the various Research Council portfolios. WSKEP took this message back to Swindon and by about half way through the programme, NERC began to acknowledge that KE needs to be undertaken on the broadest possible stage in order to benefit the needs and challenges of a wide range of users.

A frequent comment at Workshops and at PAG meetings was the perception that one of the barriers to progress was that the Research Councils did not work very well together. WSKEP learnt about a cross council group usually chaired by Philippa Hemmings of EPSRC called the Water Information Group (WIG) which met about every two months. WSKEP requested an invitation to a meeting to share with its members what it was doing. This didn't happen for various reasons; however, WSKEP did contribute in a major way to the two RCUK Water Showcase events that the WIG hosted in 2012 and 2013. The WIG fed into UKWRIP in terms of people, agendas and actions, and looked to UKWRIP to help inform future research priorities and innovation activities. WSKEP kept in close contact with UKWRIP from the start of the Programme so, to some extent, was able to influence the WIG.

During the second phase of the Programme, both BIS and NERC changed emphasis requiring WSKEP to put a greater emphasis on working with industry rather than policy makers and regulators. It took considerable time for industry groups to understand what WSKEP was seeking to do, and how it could complement industry wide needs from knowledge and innovation. This underlined the fact that building stronger research-user collaboration is a long term process. While the development processes were quite slow with some industry groups, once decisions were made to proceed, industry groups expected actions to start very quickly.

Another change in emphasis in Government partway through the Programme, was the requirement to become more outcome based and cultural (more collegiate/collaborative). This meant that there was a need to measure outcomes as well as reporting outputs. WSKEP worked towards this by following up on Workshops and events to describe what had happened as a result of the activity. WSKEP learnt that 'Water Security has a lot of challenges, voices and

opportunities and hence focusing on where the Programme could make a difference is key to delivering outcomes.' (A PAG member, March 2014)

One of the Challenges of hosting a Reception in Westminster was ensuring that the parliamentary keynote speaker was able to attend. We learnt that even when you put your best efforts into the organisation of an event, if a more important national or international event should crop up at short notice you need to be flexible. WSKEP had to change the date at a reasonably early stage and then change the time of the Reception at close to the last minute. Luckily this did not dampen spirits and a very successful event resulted.

Delivery of many of the WSKEP activities depended upon other third parties. While many of these were research organisations, the increased emphasis upon industry relevance meant that the Phase 2 activities needed a stronger industry lead when planning and delivering KE actions. This was mainly achieved by running activities lead by users rather than running a Phase 2 round of Workshops as per Phase 1.

The planning of the Phase 1 Workshop Development meeting posed a number of interesting challenges related to ensuring the outcomes represented an accurate synthesis of the major outcomes from each individual SPS workshop. This type of meeting was quite unfamiliar to many of the delegates, but through skilful facilitation and careful moderation it was possible to identify short medium and long term priorities.

In 2012, NERC took the decision to postpone the Call for KE Projects and KE Fellows. This meant that WSKEP did not have these resources to mobilise into WSKEP activities – nor did they need WSKEP support. Similarly, the cancellation of two of the planned KE Programmes, and the scaling back of the Sustainable Food Production KEP meant that there were only limited opportunities to develop synergies with the remaining programmes. WSKEP did however keep in regular contact with the MRE KEP at KEN meetings and at other times.

When NERC setup the KEPs it decided to provide them with their own Programme website set within a KEP portal. However, there were problems with establishing the portal and websites and this remained a serious problem for the whole first year of the WSKEP Programme. It was put at the top of the Risk Register as it significantly affected the way the Programme communicated with all its users and researchers. The first four Workshops were held during this period when there was no website address to give to participants to enable them to download papers or reports. The KEP portal became live but not searchable at the end of November. To access information beyond the home page, followers had to log in. This process was cumbersome and did not work properly. As a temporary solution the PMG commissioned a website to provide access to information about the Programme, news about events and activities and a source of documents. This was up and running in February and in the end was approved by NERC as the WSKEP website in March 2012.

The production of publicity material in the form of pull up banners for use at events, was an outstanding issue until November 2011. NERC was intending to provide banners for all the KEPs however, as they were needed for the first Sub Area Workshop at the end of November 2011, the PMG organised the production of their own banners which were produced on time.

The PMG was operating without the support of a Coordinator for the first six months of the Programme which created considerable difficulties. The position was only filled at the end of September 2011 when Kay Heuser joined the Group from the NERC Swindon Office. However, after that, the backlog of outstanding activities was addressed and much faster progress was made across all areas of the Programme.

WSKEP started at the beginning of April 2011, however, the Service Level Agreement (SLA) was not signed until July 2011. This presented a problem to the PMG, as, without a signed SLA a project number could not be set up for the Programme. This resulted in a lack of access to the budget and hence difficulties in paying costs for the Launch Event and expenses for PAG members to attend their first meeting. These issues were resolved in August 2011.

Unfinished Business

Summarising outstanding opportunities, unmet community needs etc.

There were a couple of engagements with businesses that started off hopefully but were not carried through to the end for various reasons. BT Research flagged interest in existing NERC research knowledge, models and environmental data relevant to the management of potential hazards and operational problems effecting critical communications infrastructure across the UK. Examples include the damage caused by flooding to active electronic systems in telecommunications junction boxes associated with intense rainfall or flood. The location of many of these boxes is often historical and would previously have contained less vulnerable passive electrical systems. Movement of rainfall across the UK is often reflected in the spatial distribution of "waves" of BT system failures. NERC activity in the

Natural Hazards partnership, projects in the Changing Water Cycle and Storm Risk Mitigation Programmes led by Newcastle, Reading, Manchester and Bristol universities, in addition to CEH and BGS strategic research, are all relevant and have been communicated to BT. Two different approaches were discussed with BT. Firstly, a NERC-funded PhD studentship with the Walker Institute in Reading. Secondly, the BT contact has circulated information supplied by WSKEP to colleagues across BT interested in weather / system faults / water. There was also interest in modelling and sensor networks to allow early warning of surface water flooding etc. There were delays in progressing these ideas and once the definitive end date of the Programme was known, it was too close to the end of the programme to follow these ideas up with BT.

Heineken, as the owner of Bulmer Cider, was interested in sustainable and responsible use of water in its main cider producing areas of Hereford. In addition to minimising water use in its factory production processes, they were looking at developing whole catchment water management using stakeholder participatory methods to achieve these objectives. At a WSKEP funded workshop organised by the ESKTN on water, agriculture and ecosystem services, Heineken indicated that it was prepared to help coordinate, under the auspices of the Bulmer Foundation, a catchment demonstration pilot action along a fifteen mile stretch of river from headwater to outfall in Hereford. This pilot would use latest natural, engineering and social science to deliver more sustainable water and whole ecosystem solutions to multiple stakeholders, including Heineken. Representatives from Heineken were invited to discuss ways forward with the WSKEP and how other resources could be mobilised to set up this pilot demonstration scheme. Again, this project did not come to fruition due to time constraints with no Phase 3 follow-on of the project.

Over the second phase of the Programme, water companies were developing the environmental elements of their five year business plans. In doing so, meeting the requirements of the Water Framework Directive was a key consideration. Both existing and future monitoring data and modelling was required. Previous investments by NERC (eg. in past major research programmes such as the Rural Economy and Land Use Programme (RELU) (jointly with ESRC) and the Land Ocean Interaction Study (LOIS) had provided large datasets and investigations of a range of future scenarios in the Humber rivers and catchments. This work integrated contributions from a wide range of universities including UEA, Exeter, Birmingham, Durham, Aberystwyth, Liverpool and Coventry in addition to Research Councils. Discussions with Yorkshire Water, indicated that these major NERC research investments had not been accessed or fully exploited, particularly with regard to linking with a diverse range of physical, water chemistry and socio-economic datasets relevant to water management. Two lines of contact into Yorkshire Water were pursued, through the Environmental Regulation Manager and Market Intelligence Co-ordinator. Information on outputs from both RELU and LOIS were offered and supplied to both contacts. The PMG invited Yorkshire Water to follow up discussions in the autumn of 2013 but after delays in finding a suitable date, the end date of the Programme became known and the contact was not pursued further. However, during the remainder of 2014, CEH will be making legacy data from LOIS available online. This act may therefore re-ignite interest.

Lafarge, as a French multinational is concerned about compliance with a new EU Biodiversity Directive. The Directive, while requiring development such as quarries to cause minimal damage to biodiversity, does not provide any agreed guidelines or methodology to define acceptable or unacceptable impacts on biodiversity. Discussions between Lafarge and WSKEP highlighted that previous research in this field had been funded by the extractive industry, Natural England, Local Government and NERC Research Programmes (eg. LOCAR and National Capability). This previous site specific advice, involving the integration of hydrogeology, soil science, plant physiology and terrestrial ecology expertise with operational engineering expertise was used to define levels at which groundwater should be maintained in areas surrounding a quarry. There was an opportunity to integrate this knowledge into a recently developed national method to assess the impacts of climate change, and especially lower groundwater levels, on wetland ecosystems and biodiversity. The National Mineral Resources Manager of Lafarge was a member of the WSKEP PAG. Restructuring of the Lafarge group in 2013, including merger with Tarmac within the UK temporarily halted further discussions on an agreed work plan. Once the Lafarge restructuring was completed in the autumn of 2013, the PAG member was no longer a member of Lafarge Tarmac and discussions went no further.

There are only two out of nearly forty WSKEP reports that are still outstanding at the time of writing this document. The Waterwise Report on ‘Communication plans for drought conditions during the 2010 – 2012 drought’ is underway. The results from an approximately1000 strong survey are currently being analysed and will then be written up. The report is expected by the end of July 2014.

The other outstanding report is about ‘Mapping water knowledge exchange within and between professional institutions and trade associations’. However, the author has produced a comprehensive stand alone Executive Summary which was distributed and discussed at a lunch meeting of eight of the top water related professional institutions and trade associations. The organisations agreed that there were areas where they could collaborate better

together to share information and they would look into this. The PAG requested that this report was completed as it would be a useful document. The PMG is continuing to request updates on progress.

Programme legacy

Summarising what will endure beyond the end of the programme and, where appropriate, how

This Programme has helped consolidate a large and active community around the topic of water security. One way this can be seen is by viewing the number of unique visits to the website and by looking at the number of twitter followers viewing the tweets, both of which have impressive statistics. It seemed a shame to break up what had taken three years to build with the close of this Programme, therefore after consideration, CEH agreed to a proposal from the PMG to host, maintain and publicise the WSKEP online tools. To do this efficiently the tools (UK Water Research Directory, WaterR2B and the Water Data Portal) were brought together into a single site, the 'WSKE Portal', to deliver savings on long term maintenance. (http://www.watersecurity.org.uk/about/) (Figure 6). A new news section and a linked events calendar were also created. The latter two features allowed the new Portal to take the place of the old WSKEP Programme website which is now linked as a legacy site.

Figure 6 The Water Security Knowledge Exchange Portal

In order that the Water Portal is kept up to date and in particular the events calendar and news page, CEH agreed to allocate some staff time to the project. The website is now being maintained on a daily basis and newsletters prepared and published on a monthly basis.

Other opportunities and collaborations were formed during the course of WSKEP as listed below. It is hoped that these will be built upon over time. For example:

- Stronger relationships were built with NERC RP programme managers, with WSKEP playing a role in the development of both the Floods from Intense Rainfall and the Droughts RP's. In addition, good contacts were built with the NERC Macronutrients Programme manager (Paul Whitehead) and interactions are ongoing with the Changing Water Cycle and Storm Risk Mitigation Programmes.
- WSKEP gradually increased its profile among the NERC science and user communities during its three year life. It is hoped this will continue. The opportunities to build cross Research Council collaboration on water KE and science has had an impact across industry and government sectors.
- UK engagement in the European Commission Joint Programming Initiative in Water (JPI) providing links to UK water research projects and programmes.
- NERC engagement in UKWRIP, a potentially powerful mechanism to build long term improvements in the UK's water related knowledge exchange. WSKEP fed SPS workshop outputs into the UKWRIP and sought to support the UKWRIP wherever possible, including following up on a workshop organised by UKWIR and Surrey University (Tony Rachwal) on Water Infrastructure research. The Water Portal will be a major part of their website providing tools and calendar information to their contacts.
- CEH engagement in the Welsh Government WERH and Scottish Government CREW, opening up opportunities for WSKEP to complement and be itself complemented through partnering with these water KE activities in the devolved administrations.
- WSKEP had the privilege to secure the services of a very proficient facilitator who has a client portfolio that includes the European Commission DG Environment and the European Environment Agency among others. Delegates at WSKEP SPS workshops have contracted him to deliver participatory workshops for their own organisations (CCN, OFWAT, Defra/EA). There is some possibility that synergies could be achieved between some of these activities.

Programme recommendations

Recommendations resulting from the WSKEP programme

At the final PAG meeting, members were asked for their thoughts on both how to develop the uptake of NERC science and the way forward for water KE. Below are their suggestions.

Key messages in developing uptake of NERC science

- Embed the supply chain at the outset of any research – look at the challenge from a stakeholders perspective

- 'Challenge –led' research must pull the end user in – and address the problems the stakeholders are facing
- The conversation with the end-user is key, don't overwhelm the discussion with academics at an early stage
- Barriers/enablers in KE, however controversial should be taken to a high level in NERC
- Research Proposals should satisfy the science excellence threshold first and then applications should then be considered with regard to what and how they will best deliver value to UK Plc
- Moderating panels should be modified and steering groups should combine academia and user interests with a stronger role in selection/monitoring processes
- Look at research centres (e.g.CEH) for communities that have a model that appears to deliver sustained impact / outcomes
- The real challenge is to meaningfully break beyond the known KE community
- Commitment from users at a strategic level is essential
- KE should be started early in the process not at the point of research output
- There is a need for multi-research funder responses – not just from NERC
- The question is how to get clarity of what the real needs are? - Process/incentives are needed to support identification process
- Research is now shifting to synthesis, making it relevant to policy and practice, but this has not changed in Knowledge Exchange

The way forward

- Water cycle research strategy for the UK regulatory and business
- Don't expect everyone to do everything – RCs do their job very well - NERC is only a small part of the jigsaw
- Research projects should have a steering group to take them from inception to implementation which should comprise research users
- There's more continuity in evolution of activity than perhaps we recognise. Opportunities to learn and build on previous experience is greater than is often acknowledged
- UKWRIP could carry forward KE activities resulting from WSKEP
- NERC should recognise the value of the online Water Portal potential for future development
- At the award stage the Research Councils have a science filter which comes first. A policy filter should also be considered at the start of the assessment process
- There is a need for greater balance where challenge is led with science excellence
- Mechanisms should be put in place to force collaboration where necessary e.g. CREW

6. WSKEP Finances

The PMG have prepared a Financial Statement for the Programme from April 2011 – March 2014. This is submitted with the Final Report. Appendix 4 gives an explanation of the figures.

Appendix 1 Sub Areas and Specific Priority Subject Workshops

The list below shows the WSKEP Sub Areas and the titles of the Phase I Specific Priority Subject Workshops.

Sub Area 1. Integrated Water Management

SPS 1.1: Assessing upstream methods of land/water management that improve water quality and quantity

SPS 1.2: Understanding and managing the impacts of climate change on the ecology of catchments

SPS 1.3: Linking natural networks and communities across rural and urban systems

Sub Area 2. Increased Resilience to Extreme Events

SPS 2.1: Improving flood prediction, communication and impact assessment

SPS 2.2: Improving drought prediction, communication and impact assessment

SPS 2.3: Supporting sustainable and resilient management of droughts

SPS 2.4: Supporting sustainable and resilient management of extreme rainfall

Sub Area 3. Ensuring Water Resource Security

SPS 3.1: Assessing the value of water

SPS 3.2: Assessing water-related business risks

SPS 3.3: Informing decision-making for water resources management

Sub Area 4. Coordination of Water Data

Sub Area 5.Sources, Behaviour and Control of Persistent and Emerging Environmental Contaminants

Appendix 2 WaterR2B Case Studies

The table below lists the WaterR2B case studies by sector and title and shows the researcher and users of the science.

Sector	Title	Academic	Organisation	Customer
Water Utilities	SewerBatt acoustic monitoring system	Prof Kirill Horoshenkov	Bradford	Acoustic Sensing Technology, Yorkshire Water
Water Utilities	How much water can be taken from a river?	Mike Acreman	CEH	EA, UK Irrigation Association
Water Utilities	How can reservoir water be kept healthy?	Alex Elliott	CEH	EA, British Hydropower Association, UKWIR
Water Utilities	How do we assess the effects of oestrogens?	Andrew Johnson	CEH	EA, UKWIR
Water Utilities	Will there be more flooding in the future?	Nick Reynard	CEH	EA, Defra
Water Utilities	Upstream Thinking for managing moorland catchment areas	Richard Brazier	Exeter	SW Water, WWF, West Country Rivers Trust
Water Utilities	Finding hidden water supplies	Dr Karen Anderson	Exeter	Quest UAV/SW Water
Water Utilities	The need for a systems approach to water management	Nick Voulvoulis	Imperial College	BP, Anglian Water, EA
Water Utilities	Reducing risks from emerging contaminants in water	Nick Voulvoulis	Imperial College	Anglian Water, Anglo American
Water Utilities	Removing endocrine disrupting chemicals and pharmaceuticals during wastewater treatment	Nick Voulvoulis	Imperial College	Anglian Water, Yorkshire Water
Water Utilities	How can we prevent dryland reservoirs filling with sediment?	Iain Reid	Loughborough	Israel Land Administration
Water Utilities	How much phosphorus needs to be removed to meet the WFD in UK rivers?	Paul Whitehead	Oxford	EA, UKWIR, Wessex Water

Water Utilities	Passive monitoring of aquatic pollutant loads over time	Graham Mills	Portsmouth	SW Water, Natural Resources Wales, Westcountry Rivers Trust
Water Utilities	Water catchment management template (RELU)	Laurence Smith	SOAS, UEA	SW Water, EA, River Trusts
Energy	iHydrogeology - mapping shale gas source rocks and groundwater aquifers	John Bloomfield	BGS Wallingford	EA
Energy	GIS tool for ground source heat pumps	Corinna Abesser	BGS Wallingford	EA, Carbon Zero Consulting
Energy	Fracking - UK groundwater methane baseline analysis	George Darling?	BGS Wallingford	EA
Energy	How can we maintain healthy river ecosystem?	Richard Williams	CEH	EA
Energy	Hydra, Catchments UK and LowFlows software	Andy Young	CEH	Wallingford Hydro Sollutions, Hydropower developers
Energy	Can water from old mine workings help to heat a city?	Dr Nicholas Hytiris	Glasgow Caledonian	City of Glasgow, Scottish Power
Farming & Food	How do groundwater flow systems affect the impact of on-farm mitigation measures on river receptor pollution?	David Allan	BGS	Defra
Farming & Food	How can we restore a degraded river	Cedric Laize	CEH	Coca Cola, EA, WWF
Farming & Food	Environmental management to sustain high quality water resources	Mike Acreman	CEH	Danone Waters, International Union for Conservation of Nature
Farming & Food	Award-winning guidelines for creating irrigation reservoirs on farms	Keith Weatherhead	Cranfield	EA, UK Irrigation Assoc
Financial & Consulting	Improved flooding risk models: LISFLOOD-FP	Paul Bates	Bristol	Willis Re, Halcrow, JBA, Ambiental, EA
Financial & Consulting	Where and when will floods occur?	Bob Moore	CEH	SEPA, Met Office, Automobile Association, HR Wallingford, EA
Health & Emergency	Assessing potential health risks from point source pollution (Low Flows 2000WQX)	Richard Williams	CEH	Drinking Water Inspectorate, Unilever
Health & Emergency	How can water quality be monitored throughot the distribution network?	Stephen Boult	Manchester	Siemens, Salamander
Health & Emergency Services	What effects do cytotoxins in drinking water have?	Andrew Johnson	CEH	Huber Technology
Industrial	Vertical Flow Reactor for treating mine water in S Wales	Devin Sapsford	Cardiff	Coal Authority
Industrial	Development of new range of wastewater treatment systems	Simon Judd	Cranfield	Balmoral Group
Industrial	Design and export of water desalination plants	Adel Sharif	Surrey	Surrey Aquatechnology, Modern Water plc
Industry	How to treat landfill leachates?	Chedly Tizaoui	Swansea University	"International"
Planning & Construction	How can weather radar help to predict flooding?	Bob Moore	CEH	Scottish Water
Planning and Construction	BGS SUDS map	Rachel Dearden	BGS Keyworth	
Planning and Construction	How can the risk of groundwater flooding be assessed, enabling better defensive measures to be designed? (SID0084, DTZ)	David Macdonald	BGS Wallingford	EA, Oxford City Council

Recreation, Sport, Leisure & Tourism	How can our lakes be kept attractive?	Stephen Maberly	CEH	Lake District Nat Park, EA
Recreation, Sport, Leisure & Tourism	How can sustainable wetlands be recreated?	Mike Acreman	CEH	EA, The Royal Society for the Protection of Birds, Wildlife Trusts, Huntingdon District Council
Recreation, Sport, Leisure & Tourism	How can angling in shallow lochs be protected?	Linda May	CEH	SEPA, The Royal Society for the Protection of Birds

Appendix 3 Programme deliverables

The table shows the outputs that were delivered by the WSKEP Programme and the date by when they were completed.

Task	Task name	Output	Proposed end date	Actual end date	Reason for deviation
			End		
1.5	Revise the plan for the Data Sub Area	Revised plan	May 2013	Sept 2013	Requirement took longer to assess
1.6	Engage with businesses to determine their KE needs	Case studies	Nov 2013	March 2014	Extended period
2.3a	Add scientific outputs to the UK Water Research Directory	Database	Ongoing to March 2014	March 2014	
2.3b	Add information on water research and demonstration facilities to the UK Water Research Directory	Database	Ongoing to March 2014	Nov 2013	
2.3c	Identify industry relevant offers from researchers who attended WSKEP SPS workshops	Report	March 2013	May 2013	Lower priority
2.4	Identify and extract industry specific outputs from NERC funded RPs	Report	March 2013	May 2013	Lower priority
2.5	Establish the Industry Impact Award scheme	Award scheme	March 2013	March 2014	Extended
3.1a	Take the Data Sub Area forward	Data Portal	Sept 2013	May 2014	HLE took priority
3.1b	Review of assessment of communication plans for drought conditions during the 2010-2012 period	Comms plans	Sept 2013		Unrealistic date & slow to complete
3.2a	Organise one-to-one activities with key industry sectors contacted during User Based Activities of the first phase of WSKEP	Varied	Ongoing to March 2014	March 2014	
3.2b	Organise one-to-one activities with policy makers and regulators contacted during User Based Activities of the first phase of WSKEP	Varied	Ongoing to March 2014	March 2014	
3.2c	Raise the profile of health impacts of extremes	Report	Feb 2013	March 2014	Slow to set up contract
3.2d	Engage with stakeholders about their operational risk assessments	WSBF Report	Initial meeting Dec 2012	March 2014	
3.2e	Identify synergies between different users around management of water	AMEC Report	May 2013	May 2013	
3.2f	Engage with stakeholders about anticipating future change and implications for policy and businesses	Report from CIWEM Annual meeting	Initial meeting Dec 2012	April 2013	Annual meeting held in April
3.2g	Engage with businesses to facilitate access to NERC knowledge	Initial mtg with Coca Cola and M&S etc.	Nov 2013	March 2014	Extended period
3.3a	Synthesise outputs from ecosystem services research initiatives	Report	March 2013	July 2013	Slow to set up contract
3.3b	Review plans for current RPs and identify existing and potential decision support tools	Report	March 2013	June 2013	Lower priority
3.3c	Outputs from WSBF round table meetings	Reports	Ongoing to March 2014	March 2014	

4.1	Inform SIM's, to improve industry involvement in NERC RP's	Inc industry attendances at Town mtg	Ongoing to March 2014	March 2014	
4.2	Liaise with the other KE Programmes	Meetings / discussions	Ongoing to March 2014	March 2014	
4.3	Manage information relating to KE and research funding calls	Info on the website	Ongoing to March 2014	March 2014	
4.4	A compendium of case studies	Info on the website	Ongoing to March 2014	March 2014	
4.5	A calendar of KE events	Info on the website	Ongoing to March 2014	March 2014	Ongoing for another year
4.6	Management of a register of KE activities	Info on the website	Ongoing to March 2014	March 2014	
4.7	Maintenance and management of the WSKEP website	Website	Ongoing to March 2014	March 2014	Ongoing for another year
5.1a	Maintain and update the Communication Strategy	Comms Report	Ongoing to March 2014	March 2014	
5.1b	Prepare a glossy brochure	Report	Feb 2013	N/A	Information put into WaterR2B
5.2	Organise a High Level Event	Event	Nov 2013	Nov 2013	
6.1	Prepare six industry case studies (See Task 1.6)	Case studies on WaterR2B	Nov 2013	Mar 2014	More added following review
6.2	Presentations to disseminate good KE practice	Presentations	Ongoing to March 2014	March 2014	
7.1	Organise PAG meetings	Meetings	Ongoing to March 2014	March 2014	
7.4	Prepare Interim and Annual reports	Reports	Ongoing to March 2014	March 2014	
7.5	Prepare an end of Programme Evaluation Report	Final Report	March 2014	June 2014	See Section 5 of Final Report

Appendix 4 Financial Statement

The PMG have prepared a Financial Statement for the WSKEP Programme from April 2011 – March 2014. This is submitted with the Annual Report.

Summary Statement[1]

The total expenditure incurred by the WSKEP during the life of the programme 2011/14 was £1,577,204.11 against a total budget of £1,882,001.83 an under spend of £304,797.72 of which the NERC contribution at 80% FEC was £1,261,763 against a budgeted NERC contribution of £1,484,000.00. Below is an explanation for each sub section of the Statement.

Staff Costs

Staff Costs for 2011/14 were £776,382.72 against a total budget of £684,801.83. Against the original budget the programme incurred an over spend in this category to cover additional staff costs to deliver the objectives within the 3 year timeframe. It was agreed with NERC Swindon Office that the budget for staff costs in year 1 could be increased from £184,119.00 to 234,119.00 and in year 2 they were increased from £253,328 to £303,328 by redistributing funds budgeted for recurrent costs to the staff costs budget.

Non-Staff Costs

Against an allocated Non-Staff budget of £1,197,200.00 the expenditure was £800,821.39, an under spend of £396,378.61.

[1] All financial data is reported at Full Economic Cost (FEC) unless other stated.

Travel and Subsistence

Travel and Subsistence expenditure for 2011/14 was £34,850.22 against a total budget of £49,600.00 and therefore represented an under spend of £14,749.78 against this budget line. This under spend is a result of reducing the number of staff attending events due to other work commitments.

Consumables (inc Literature and Marketing).

Expenditure for consumables during 2011/14 was £13,935.64 against a total budget of £15,700.00. Due to transferring responsibility for graphic design and printing from NERC Swindon Office to external contractors working directly to WSKEP – the bulk of the expenditure on literature, banners and publicity material is reported under the Contractors heading below. The spend under Consumables reflects initial costs associated with material produced to promote the website, and the UK Water Research Directory. Although there is an under spend of the total budget there was an over spend in year in 2012/13 year 2 of the programme. This was due to the development of the WaterR2B website which had not been anticipated at the beginning of the programme.

Events – hosted by the KEP

WSKEP hosted ten workshops which were organised by different host organisations to increase the attendance to the workshops. WSKEP also hosted a number of smaller meetings including the 'Innovative and radical groundwater recharge, storage and resource development' workshop and the 'Improving collaboration between trade and professional associations' meeting. Expenditure on these events was £88,607.10 against a budget provision of £46,580.00 – representing an over spend of £42,027.1. The over spend against this budget line was due to the cost of the host organisations arranging the workshops on the programmes behalf. However, the programme achievied cost savings by using a single event facilitator which meant that funds were available to cover these costs.

Events – General Promotion

Substantial additional resource was allocated to general promotional activities above the provisions made in the Business Plan at the start of the Programme. The expenditure on this budget line in 2011/14 was £61,367.10 against a total budget of £26,700. The greater priority given to this area was required to respond to the need to raise the profile of water research, KE and innovation at political levels. Other events that the programme sponsored have included three CIWEM annual conferences and in total eight parliamentary events hosted by the All Party Parliamentary Water Group, British Water and CIWEM. The programme has also supported three Westminster Sustainable Business Forum events and a number of CIWEM conferences which were related to the programme's specific priority subject areas.

Events – Attended

WSKEP staff attended a number of water security related conferences, where WSKEP was publicised. Expenditure against this budget lines was £3,004.06 against a total budget provision of £24,400. The low expenditure reflects that many of the events have been free to attend and just travel expenses have been charged to the programme. Also, where the programme has sponsored conferences and events a number of places have been included to attend these events. Sponsoring the conferences and events has been part of the general promotion of WSKEP and has helped in raising awareness and the profile of the programme.

Contractors – event facilitation

Expenditure during the programme was £121,253.68 against a total budget of £462,520.00 representing and under spend of £341,266.32. The use of a single event facilitator has enabled the programme to achieve costs savings – while delivering a far greater coherence in the design, delivery and outputs of the different workshops. This has allowed the workshops to be hosted and organised by the relevant organisations. There has also been a reduction in the number of workshops originally planned at the start of the programme in order to achieve the programme objectives set out in the second phase of the programme. Due to the under spend, funds were available to cover the costs of different organisations hosting the events and to cover additional staff costs incurred in order to deliver the programme objectives within the 3 year timeframe of the programme.

Contractors – report writing

The number of reports commissioned was lower than expected due to other activities being funded under Contractors-other. Report writing has included 'Collaborations arising from WSKEP workshops' which provided useful evidence on the impact of the workshops. The case studies for the WaterR2B case study website and the mapping of Water

Research and Innovation Networks. Expenditure under this budget line was £138,220.40 in 2011/14 against a budget of £151,930930, an under spend of £13,709.60. Report writing in regards to the SPS workshops was allocated to either the event facilitation or CEH staff cost budget lines.

Contractors – others

Expenditure for other contractors during 2011/14 was £335,035.20 against a budget provision of £411,570.00 – an under spend of £76,534.80. Under this heading are the costs associated with taking on design, literature and the web site – and of using an external communications company. Also included under this budget line are the actions commissioned through industry groups, trade and professional associations, and university groups prepared to undertake KE activities targeting key industry sectors and/or government bodies. The budget was increased in year 3 of the programme as it was anticipated that more work would be required to be contracted out to complete the objectives of the second phase of the programme. However much of the work was carried out in the second half of year 2 which resulted in an over spend against this budget line in year 2.

Equipment

A small amount of equipment has been purchased over the 3 year period of the programme totalling £2,199.78. This has included equipment to display publicity material at events, hiring of pin boards for the workshop and the Vodaphone accounts for the two iPads to support WSKEP communications at exhibitions.

Other Costs

Other costs for 2011/14 totalling £2,348.21 against a total budget allocation of £6,000.00 were made for various items including membership to ICID, Postage and Courier services for sending publication material to events, and some insurance costs for transporting WSKEP publicity material around the UK. Overall there was an under spend of £3,651.79 as it was anticipated the programme would incur greater postage costs.

Finance Conclusions

The overall expenditure of the programme resulted in an under spend of £304,797.72 against the budget, with some redistribution between the different budget lines. This redistribution of expenditure is to be expected with additional staff costs and change in focus of the programme. The revised Programme Framework meant that there was a change in the budget allocation in order to achieve the deliverables that were agreed in the Framework. The remaining budget for ‘Contractors – event facilitation’ was distributed to areas of the budget that required greater spend. Although it had been anticipated that there would be a greater spend in ‘Contractors – other expenditure’ there had been an over estimate due to some tasks being carried out by programme staff which were originally planned to be contracted out externally. Also, given the changes to the programme there was an insufficient lead time to allow full use of the budget intended to be spent on external consultants.